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GEOLOGICAL, PETROCHEMICAL AND GEOCHEMICAL STUDIES ON THE SHAIT GRANITE AT WADI SHAIT, EASTERN DESERT, EGYPT.

Samir El-Gaby & Mourtada El-Aref

Geology Department, Assiut University, Egypt.

The gneissose Shait granite was remapped and differentiated in the field into various intrusions. Samples from the different granite varieties were analysed for the major and for some minor elements. Field relations and the petrochemical and geochemical properties indicate that the Shait granite of tonalite composition belongs to the early members of the synorogenic granitoids, i.e. the grey granites.

INTRODUCTION

Schürmann (1953) introduced, in his classification of the Egyptian basement complex, the 'Shait Granite' as a representative of an old Shaitian Plutonic Cycle separating the Eparchean from the Metarchean. This classification initiated some controversy among geologists working on the Precambrian of Egypt. El-Ramly and Akaad (1960) doubted the validity of separating the 'Shait Granite'. Moustafa and Akaad (1962)and Akaad and Moustafa (1963) studied the 'Shait Granite' at its type-locality.However,they were unable to settle the disbute about the stratigraphic position of this granite due to lack of conclusive field evidences regarding the exact age relation towards the epidorites.

Some authors investigated Shaitian type granites occurring in other localities in the Eastern Desert of Egypt. Akaad and El-Ramly(1963)studied the Shaitian type granite at Gabal El-Mayit, Central E.D., and reached the conclusion that the Shaitian granites or granites of Shaitian type are but sheared representatives of the grey granites of El-Ramly and Akaad (op.cit). El-Shazly et al.(1971) studied some granite-like

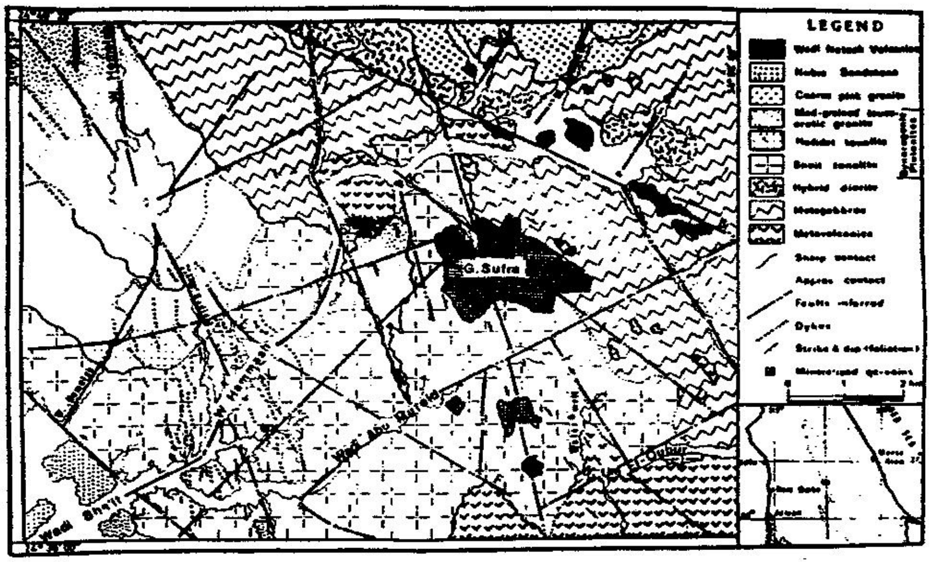

Fig. 1: Geological map of the Wadi Shait area, Eastern Desert, Egypt.

pebbles from a metamorphosed conglomerate bed within the metasediments. They considered these pebbles on petrographical, petrochemical and geochemical reasoning equivalent to Wadi Shait plagioclase granite (El-Shazly, 1964), i.e. the Shaitian granite must have been emplaced at least during the late depositional phases of the metasediments.

The present authors believe-regardless of how far it is justified to assume that the Shaitian type granites are geologically identical with the Shaitian granite of Schürmann - that the problem of the Shaitian granite must be settled at its type locality. The area of Wadi Shait , E.D., has been remapped recently (El-Gaby et al., 1976). The granitic rocks outcropping there were investigated petrographically and some samples were analysed. The obtained data are treated in the present publication.

GEOLOGIC SETTING

The northeastern half of the studied area is largly occupied by a metagabbro-diorite complex and less important metavolcanics, whereas the remaining southwestern half is covered by variably cataclased granitic rocks; the Shait Granite'. The sheared area is bounded from the NE by a major fault extending for very long distances to the east till the area of Wadi El-Gemal. A small part of a younger granite intrusion , the coarse pink granite of Hammash Gold mine (Moustafa and Akaad, op. cit.), apparantly enclosing old volcanic roof pendants occurs to the north of this major fault. A swarm of unsheared post-granite dykes trending NNW-SSE dissects the sheared granites in the southwestern part. These dykes comprise mainly granophyres and rhyodacites beside some andesites. The crystalline basement rocks were peneplained and covered by Nubia sandstones interbedded with trachyte sheets of Upper Cretaceous age.

OCCURRENCE AND FIELD RELATIONS

Field mapping revealed that the sheared granitic rocks , the'Shait Granite' s. l., can be separated into different

intrusions that were intruded into the older metavolcanics and metagabbro-diorite complex. Accordingly the so-called 'Shait Granite' is considered equivalent to the grey granites (El-Ramly and Akaad, 1960) or to belong to the synorogenic plutonites (El-Shazly, 1964; El-Gaby and Ahmed, 1975).

The synorogenic plutonites, covering most of the southwestern half of the map area, are divided according to field relations into (1) gneissose tonalites and (2) fine to medium-grained leucocratic granites. The gneissose tonalites represent the typical 'Shait Granite'. They are further differentiated in the field into (a) Shait tonalite and (b) Hadidat tonalite. The fine to medium-grained leucocratic granites constitute two separate bodies, viz.
(a) Hemeish granite and (b) foliated granite.

Shait tonalite is the most widespread rock type in the studied area. It intrudes the metavolcanics to the south of Wadi Um El-Qubur. It is also intruded into the metagabbros. This is clearly displayed on the northern bank of the E-W sector of Wadi Hammash. Besides two minor exposures of Shait tonalite pierce through the metagabbros to the west of Wadi Garadan. The Shait tonalite is intruded in turn by the Hadidat tonalite and the foliated granite. It is also traversed by the unsheared post-granite dyke swarm.

The Shait tonalite carries abundant amphibolite and metavolcanic xenoliths of various dimensions particularly to the north of Wadi Um El-Qubur and around the entrance of Wadi Hammash. It is variably sheared ranging from mildly cataclased rocks, fractured and brecciated rocks, gneissose tonalite to proper mylonites, the latter are confined to old faults. Shearing decreases generally towards the north and the west. The mildly cataclased Shait tonalites are coarse-grained, dark grey to greenish grey in colour with a perceptible granitic texture. These rocks are characterized by the occurrence of light blue amethystic quartz. They exhibit weak but noticeable foliation trending roughly NW-SE and dipping at 50° NE.

The fractured and brecciated rocks are medium to coarse-grained and enclose elongated feldspar porphyroclasts subparallelly disposed in a foliated groundmass of greyish green colour. They are distinctly foliated and break easily along the foliation planes which display crude lineation marked on these planes. The number and size of the plagioclase and quartz porphyroclasts dwindle rapidly in the gneissose Shait tonalite and they are commonly transformed into thin flat eyes and lenticles streched parallel to the foliation. The mylonites are extremely fine-grained,light pink in colour and of flaggy and banded nature.They simulate quartzo-feldspathic schists.

Hadidat tonalite occurs in the northwestern part of the map area. It is intruded into the Shait tonalite and the metagabbros. It is intruded by the Hemeish granite. The Hadidat tonalite is medium to coarse-grained and of pale pink colour with green clots. It is very weakly foliated and possesses also pale blue quartz.

Hemeish granite occupies the northwestern corner of the map area. It possesses locally a fine-grained foliated marginal part. It is intruded into the metagabbros and the Hadidat tonalite. A small pegmatitic mass is intruded into the centre of the mapped part. The marginal part is fine-grained and of pale pink to pink colour. The rocks in the inner part of this intrusion are medium-grained, massive and of dull pink to reddish pink colour with dark green clots.

Foliated granite is intruded into the Shait tonalite between Gabal Sufra and Wadi Hammash. It is fine-grained,leucocratic and of pale pink colour. It is highly sheared and foliated. It breaks easily along the foliation which trends NNW-SSE and dips at 50-60° ENN. The foliated granite occurrence is bounded on both sides by faults along which the granite is highly sheared and even mylonitized.

Petrography

Akaad and Moustafa(1963) gave a detailed petrographic description of the gneissose tonalites. Hereafter , a concise

petrographic description is given for the sake of completion.

Shait tonalite with mildest signs of cataclases consists mainly of plagioclase, quartz and little biotite together with accessory iron oxides, sphene and apatite. Plagioclase(An_{31-27}) occurs as euhedral equant crystals, up to 5 x 2 mm, that are commonly zoned . It is frequently corroded by quartz. Quartz forms large areas, up to 3 mm across, usually consisting of few individuals. It is sometimes granulated with sutured outlines. Biotite commonly occurs in aggregates of greenish brown flakes, 2.5 x 1 mm, concentrated along micro-shear planes.

A slight increase in the degree of shearing is marked by the appearance of fluid-pores (Harker, 1962) along shear planes consisting of quartz,chloritized biotite, iron oxides and epidote. Generally, they border the plagioclase crystals. At a further stage, but still prior to the yielding of the rocks to acting stresses by actual fracturing, elongate quartz aggregates are drawn-out into thin undulating streaks that usually pinch out into thin and curved lenticles. In these two stages, plagioclase commonly possesses bent twin lammellae and trimmed corners; fracturing is not uncommon and the cracks are filled with sericite and carbonates.The formerly big quartz crystal are brocken into several individuals and the outer borders are granulated giving rise to incipient morter structure. The quartz crystals usually display intricate sutured outlines.

When the acting stresses exceeded the strength limite of the tonalites, they yielded by fracturing particularly along crystal borders. The broken off angular fragements are finely granulated and comminuted giving rise to morter structure. At a further stage, the rock was subjected to large scale fragementation or brecciation. Lenticular porphyroclasts,still having corners and angular edges, are left embedded in a finer grained groundmass.

During a more advanced stage of shearing and pronounced differential movement along the shear planes, banded gneissose

tonalites and augen gneisses are developed before passing into mylonitoids and mylonites. The augen gneisses are characterized by the occurrence of discrete and interconnected lenticles, up to 8 x 4 mm, of late or rather recrystallized quartz giving the rocks their distinguished augen structure.

The quartz lenticles are streched in the mylonitoids and mylonites into very thin leticles or even into streaks. The number of the still existing plagioclase and quartz porphyroclasts is highly reduced. They commonly possess rather rounded elliptical shapes. The small biotite and chlorite flakes are usually subparallelly arranged in wavy streaks.

Hadidat tonalite is essentially composed of plagioclase and quartz together with small amounts of potash feldspar and biotite. Iron oxides and few apatite and zircon granules are the normal accessories. Hadidat tonalite is also affected by cataclasis but of limited magnitude. Plagioclase (An 24-28) is generally subhedral and the crystals are granulated and commonly corroded with quartz. Quartz is marginally granulated with highly sutured outlines. It is commonly drawn-out in the groundmass. Potash feldspar occurs as streched and drawn-out microcline perthite with highly granulated outlines. Biotite, completely altered to chlorite, occurs in aggregates of bent flakes.

Hemeish granite is similar in its inner parts to the Hadidat tonalite except for its content of biotite. It consists of plagioclase, quartz, potash feldspar and little amounts of biotite. It bears signs of mild cataclasis.

The fine-grained marginal part is composed of sodic oligoclase and quartz with very little amounts of biotite and potash feldspar. It is locally cataclased, but the hypidiomorphic granular texture is well preserved.

Plagioclase (An 15) occurs as euhedral to subhedral crystals, up to 1.5 x 0.5 mm, as well as laths of about 1 mm long. They are usually zoned, bent and broken. Quartz occurs as highly strained and squeezed patches, up to 3 mm long. The crystal boundaries are granulated and/or sutured. Quartz actively

corrodes plagioclase, potash feldspar and biotite. Potash feldspar occurs dispersed in the groundmass and may form plates of microcline perthite 0.7 x 0.5 mm. Biotite forms olive green flakes, up to 4 mm long, showing varying degrees of alteration to chlorite.

Table : 1 Modal analyses of synorogenic plutonites

Type of rock	Sample No.	k-fldsp.	Plag.	Quartz	Biotite	Access
	M 2	-	51.7	45.0	3.1	0.2
	K 3	-	55.4	40.2	3.4	1.0
	6 4'	-	56.2	42.4	1.0	0.4
	K 4	-	58.3	37.1	3.7	1.0
Shait tonalite	H 2	-	75.0	21.1	2.4	1.5
	G 3	-	63.6	30.0	5.7	0.6
	K 2	-	45.1	44.3	9.0	1.7
	M 3	-	47.9	46.4	5.3	0.3
	H 3		53.4	36.6	8.5	1.6
	M 5	6.9	53.9	30.2	7.5	1.6
Hadidat tonalite	K 6	9.1	49.9	31.4	8.3	1.4
	L 5	8.9	45.8	37.0	7.2	1.1
Hemeish granite	6 2 c	4.7	61.4	32.7	0.7	0.5
(marginal part)	L 7	4.9	59.7	34.3	0.5	0.7
	62 b	3.9	59.4	35.2	0.8	0.7
	37	14.8	41.6	39.6	3.0	1.0
Foliated granite	54	19.8	38.9	35.6	4.5	1.0
	36	17.1	39.3	38.6	4.0	0.8

Coarse pink granite of Hammash gold mine is coarse-grained with typical hypidiomorphic granular texture. It is composed of nearly equal proportions of quartz, oligoclase (An 18-23) and perthitic potash feldspar and appreciable amounts of biotite.

Potash feldspar and quartz are commonly intergrown in the groundmass in a micrographic texture.

Modal Analysis

The modal composition of the different granite types are given in Table 1, and the modal proportions Qz-Plag-Kf are plotted in Fig.2, where all the plots fall within the fields of tonalite and granodiorite.Except for the marginal part of Hemeish granite, the amount of potash feldspar increases progressively in the younger intrusions.The gneissose tonalites are highly comparable with the grey granites.The coarse pink granite of Hammash gold mine is of adamellite composition, where the plagioclase and potash feldspars are of subequal amounts.

Petrochemistry

A. Chemical Analysis

Granite samples were analysed by the first author at the Mineralogical-Petrographical Institute, University of Munich, Germany. SiO_2,Al_2O_3, total iron (as Fe_2O_2), CaO, K_2O,TiO_2 and MnO were determined by X-ray fluorescence on fused tablets with added internal standards. MgO was obtained by difference from potentiometric titration of CaO + MgO with E.D.T.A.; CaO was also checked by this method.FeO was also determined potentiometrically by the titration with potassium dichromate and Fe_2O_3 was obtained by difference. The alkalies K_2O, Na_2O, and Rb were determined by a very sensitive flame photometer. P_2O_5 was determined colorimetrically. The obtained data are given in Table 2.

Analyses No. 1, 2 and 3 (mildly cataclsed Shait tonalites) approach the mean value of biotite tonalites given by Nockolds (1954). They resemble analysis No. 4 (El-Sokkary,1970). The given content of K_2O is, however, very high although the reported modal analysis reveals that potash feldspar is absent and that biotite constitutes only 10.5 vol. %. Moreover, the MgO content is apparantly high on the expense of CaO. These values caused marked displacement of the plots in the respective diagrams.

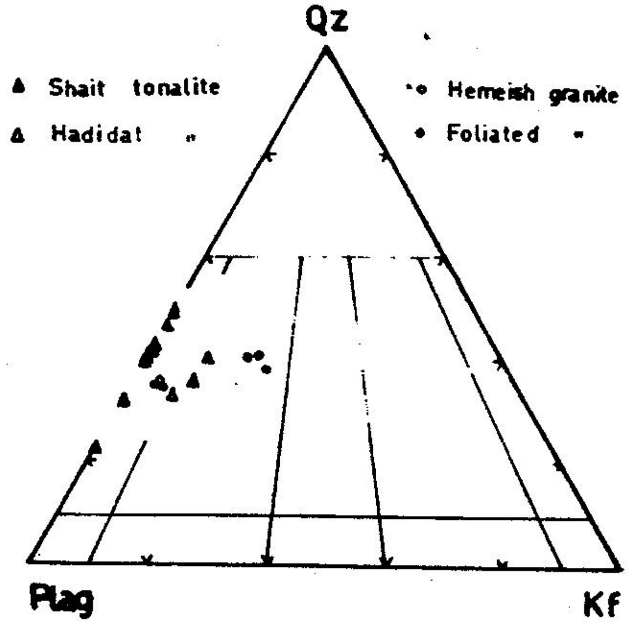

Fig . 2: Ternary diagram of the modal proportions quartz-plagioclase-potash feldspars in the studied granitic rocks.

Analysis No. 6 (mylonitized Shait tonalite) should be regareded critically since the contents of SiO_2 and Al_2O_3 were inconsistent in repeated analyses. Hadidat tonalite (No.7)is slightly more acidic than the Shait tonalites and in agreement with the modal composition. The marginal part of Hemeish granite was analysed because of its freshness. Later petrographic investigations showed salient differences between the main mass and its margin, so that a common parentage or direct genetic relationship is doubted. The chemical composition of the marginal part (No.8) is very queery and the high Na_2O content approches that of alkali syenites and trachytes.

The foliated granite simulates both mineralogically and chemically (regardless of the high silica content which might be due to change accompanying shearing)the medium-grained two-mica granites described from Southwestern Sinai (El-Gaby and Ahmed, 1976). The chemical composition of the coarse pink granite(No. 10) lies close to the mean value of the biotite-muscovite granodiorite (Nockolds, 1954); the contents of Al_2O_3 are,however, somewhat lower and that of total iron is somewhat higher.

B. <u>Niggli-values</u>

The computed Niggli-values (Table 3) are plotted on the appropriate C and D-Diagrams (Fig. 3) of Niggli (1954). All plots fall on the positive side of the al-alk. The more basic Shait tonalites (1,2,3,5 and probably 4) lie in the field of the alkali-calc-alumino-silicate rocks (III). The other plots fall in the field of alkali-alumino-silicate rocks (I and II).

C. <u>CIPW weight norms</u>

The computed weight norms are reported in Table 3 and the Q-Or-Ab and An-Ab-Or norm proportions are plotted in Fig.4.The plots of the gneissose tonalites fall close to the Ab-Q sideline similar to the early phases of the grey granites(El-Gaby, 1975). The plots of the samples having less than 80% normative Q+Ab+Or do not differ from those with more than 80%. The plot of the marginal part of the Hemeish granite falls close to the Ab-Q eutectic at approximately 3000 bars water vapour-pressure (Tutttle and Bowen, 1958). The foliated granite and the coarse

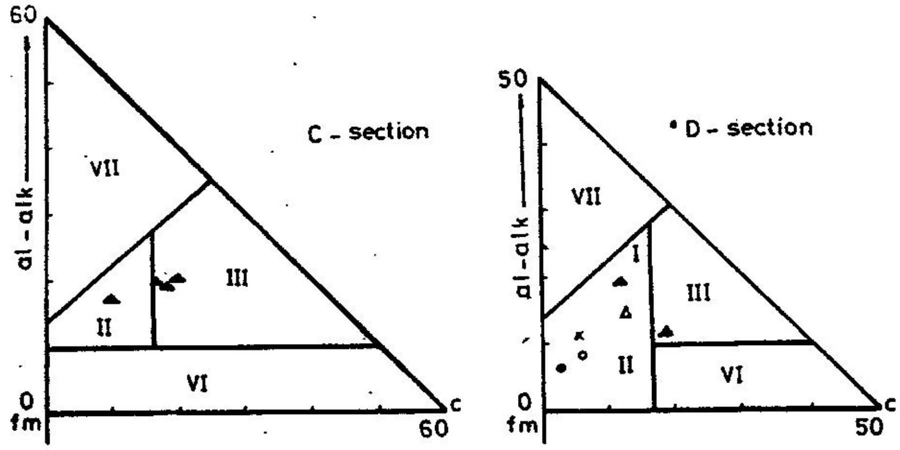

Fig.3: Niggli-diagrams of the analysed granitic rocks; symbols as in Fig.4. I&II = Alkali alu- silicate rocks; III = Alkali-calc alu - silicate rocks.

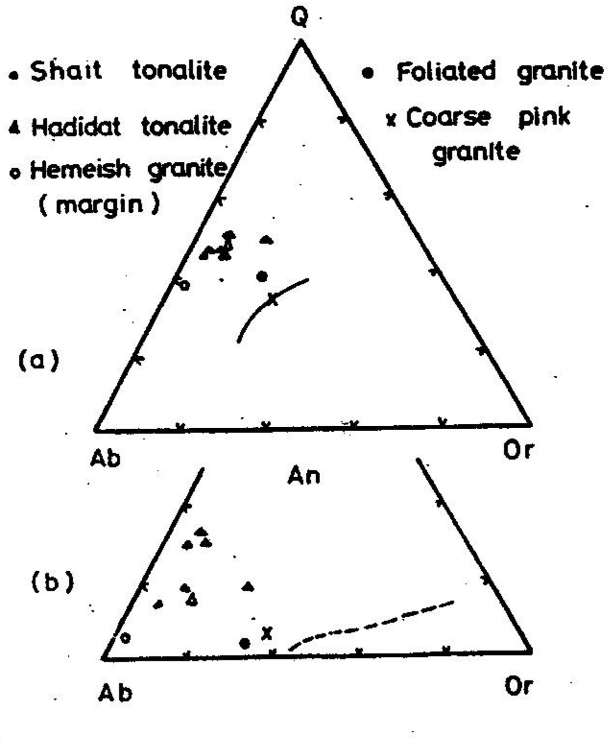

Fig.4: (a) Normative Q-Or-Ab and (b) Or-Ab-An proportions of the analysed granitic rocks. The solid line represents the trace of the isobaric minima or ternary points of the granite system at water vapour pressures from 0.5 to 10 kb (tuttle and Bowen, 1958, and Luth, Jahns and Tuttle, 1964). The dashed line represents the two-feldspar boundary curve for the quartz-saturated feldspar system at 1 kb water vapour pressure (James and Hamilton, 1969).

pink granite approach or coinside, respectively, with the low temperature ternary minima of the granite system at intermediate water vapour-pressures (Luth, Jahn and Tuttle, 1964). In Fig. 4b, all the plots-except for the foliated granite and No 5 to some extent-show a normal attitude,whereby the more basic varieties lie deep in the plagioclase field and approach the feldspar cotectic line in the younger more acidic varieties.

Geochemistry

In the following pages, interset is given to the absolute and relative abundance of some trace elements. Beside Li and Rb, the contents of the elements Y, Yb, Zr, Sn, Ni, Sc, V,Cr, Ba and Sr were determined in duplicates by a large grating emission spectrograph (RSV) with Pd as an internal standard.The obtained data are reported in Table II, and a general variation diagram (Fig. 5) is constucted by plotting the contents versus the modified Larson factor (Nockolds and Allen, 1954), which is simply refered to here as differentiation index D.I. It is to be noticed, that the reported high content of K_2O in sample No. 4 has obviously shifted its relative position along the D.I. axis towards the acid side.

Vanadium, Scandium, Chromium and Nickel

These elements decrease continuously in the calc- alkaline igneous rock series (Nockolds and Allen, 1954) and in the Egyptian granite series (El-Gaby, 1975) as the more acid rocks are reached. The more basic Shait tonalites (No. 1, 2 and 3 as well as 4 possess the highest values of 39-67 ppm V.These values are for below that of the high Ca-granites(Turekian and Wedepohl, 1956) with which they should be compared. They lie, however, within the range described by El-Gaby from the grey granites of Egypt. Vanadium content decreases in the more acid Shait tonalites and in the Hadidat tonalite and it reaches its lowest value (4 ppm) in the foliated granite. The pink granite of Hammash gold mine displays with 37 ppm an astonishingly high value for a younger granite.

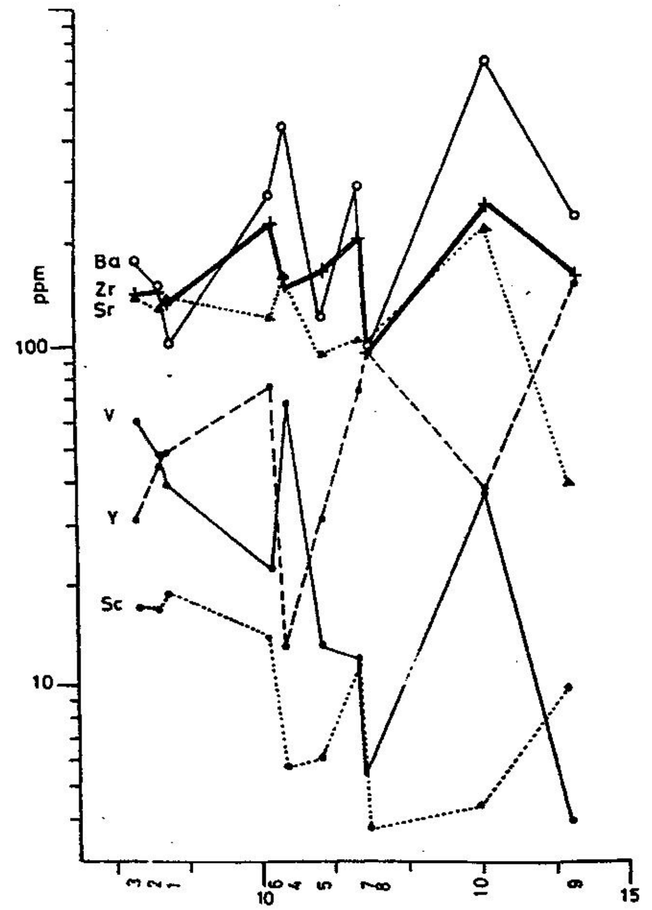

Fig. 5: Variation diagram of some minor elements in the studied granitic rocks plotted against the modified Larsen factor (Nockolds and Allen, 1953).

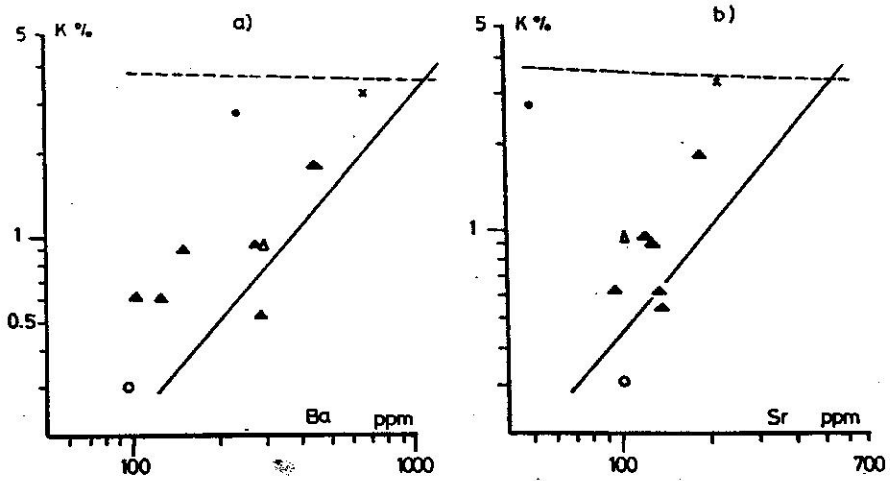

Fig. 6: Variations of Ba and Sr contents with K. The solid lines and the dashed lines represent the gregression lines of the grey granites and the younger granites, respectively, computed from the data given by El- gaby (1975).

Table II: Chemical analysis of major elements (%) and trace elements-(ppm) of granitic ro rocks at Wadi Shait

Serial No.	1	2	3	4	5	6	7	8	9	10
Sample No.	m2	12	-	-	H 1	64'	64	62 B	54	-
SiO_2	71.74	68.52	71.01	71.94	75.68	75.38	76.06	76.62	77.23	70.68
TiO_2	0.394	0.347	0.380	0.640	0.254	0.348	0.248	0.111	0.103	0.540
Al_2O_3	13.76	14.85	13.68	13.70	13.25	12.23	12.66	12.90	12.80	14.78
Fe_2O_3	1.07	2.53	2.25	1.00	1.01	0.96	0.61	0.48	1.05	1.42
FeO	3.11	2.38	2.14	1.97	0.65	2.89	1.80	0.07	0.11	1.73
MnO	0.080	0.074	0.080	0.060	0.037	0.073	0.062	0.029	0.022	0.054
MgO	0.87	0.71	0.89	2.16	0.56	0.46	0.54	0.28	0.31	0.86
CaO	3.59	3.61	3.81	1.84	1.94	3.19	1.59	0.88	0.47	0.97
Na_2O	3.85	3.98	3.66	3.19	5.22	4.53	4.40	6.60	4.55	4.20
K_2O	0.75	1.10	0.64	2.08	0.70	1.12	1.15	0.36	3.27	3.79
P_2O_5	0.092	0.130	0.140	0.050	0.090	0.092	0.071	0.071	0.070	0.180
Total	99.306	98.231	98.340	98.630	99.391	100473	99.551	98.761	99.895	99.034
D.I.	8.7	8.6	8.3	10.3	10.8	10.1	11.3	11.4	14.2	13.0
Sn	1.0	1.0	3.5	n.d.	1.0	1.0	1.0	1.1	1.1	4.7
V	39.0	8.0	61.0	67.0	13.0	22.0	12.0	5.5	4.0	37.0
Zr	132.0	143.0	140.0	148.0	265.0	225.0	205.0	93.0	160.0	256.0
Y	48.0	44.0	31.0	13.0	31.0	75.0	74.0	100.0	155.0	38.0
Yb	2.6	2.5	5.5	2.8	2.3	3.6	4.0	6.0	7.0	13.7
Sc	18.8	17.0	17.3	5.8	6.2	14.0	12.0	3.8	10.0	4.5
Ni	7.4	6.5	7.0	3.6	6.6	6.2	5.8	6.2	8.4	8.6
Sr	135.0	125.0	135.0	158.0	92.0	118.0	103.0	102.0	50.0	222.0
Ba	100.0	145.0	275.0	440.0	120.0	275.0	290.0	95.0	240.0	680.0
Rb	18.0	9.0	15.0	20.0	15.0	20.0	33.0	15.0	72.0	113.0
Li	11.5	10.0	7.3	n.d.	3.5	6.5	9.5	36.0	7.5	16.0
Cr	22.0	6.0	17.0	3.3	9.0	14.0	10.5	10.0	80.0	18.0

n.d. = not determined 1. Shait tonalite (mildest cataclasis) 2. Shait tonalite(brecciated) 3. Shaitian granite (El-Gaby,1975) 4. Shaitian granite (El-Sokkary,1970) 5.Shait tonalite (tractured) 6. Shait tonalite (mylonitoid) 7. Hadidat tonalite 8.Hemeish granite (marginal part) 9. Foliated granite 10. Coarse pink granite

The more basic Shait tonalites (Nos. 1, 3 and 10) contain the highest amounts of Sc as expected Scandium decreases towards the acid end.

Chromium and Nickel do not show any systematic variation. The foliated granite contains the highest content of Cr;it is also very rich in Ni and Sc. Further study is required to give a satisfactory explanation. The more basic Shait tonalites (No. 1 and 3) possess the normal Cr content for high Ca-granites . The pink granite of Hammash displays again a high Cr content for a younger granite.

Lithium, Rubidium, Strontium and Barium

Lithium and the Li/Mg ratio increase progressively in the calc-alkali rock series towards the acid end (Nockolds and Allen, 1935). The Shait tonalites display low Li content similar to the grey granites (El-Gaby, 1975). The pink granite of Hammash shows a higher Li content, but the highest value is given by the fine-grained marginal part of the Hemeish granite.

The abundance of the large ion elements Sr, Ba and Rb is generally directly related to the feldspars.The greater part of the Sr and Ba content of the granitic rocks is concentrated in the plagioclase and potash feldspars respectively(Nockolds and Allen , 1953). According to these authors,both Sr and Ba build up to a gentle maximum, in the tonalitic and granodioritic rocks, then drop rapidly as the acid end is approached; Rb seems to follow K in that it increases with increasing silica. El-Gaby (op.cit.) plotted the contents of both Sr and Ba of the Egyptian granites versus K. He found that both Sr and Ba increase in the synorogenic granitoids with the increase of K till its junction with the younger granites where Sr, followed shortly by Ba, displays a rapid drop with the continual increase of K. In Fig. 6 the contents of Sr and Ba are plotted against K and the regression lines of Sr and Ba are computed and drawn for the grey granites and the younger granites from the data given by El-Gaby (op.cit.). It is clear that all plots of the Shait and Hadidat tonalites fall close

to the regression lines for the grey granites. The pink granite of Hammash displays a transitional feature to the younger granites; Sr shows a decrease whereas Ba reaches its highest value. The foliated granite displays a decrease in both Sr and Ba; a character pertaining to the more differentiated residual granitic liquids.

Rubidium proxies for K in potash feldspars and in micas . to its larger ionic radius relative to K. Accordingly, the K/Rb ratio is usually considered indicative of the degree of differentiation (Shaw, 1969). A difficulty is posed, however, by the presence of biotite which has more tolerance for the large Rb ions. In other words, the presence of large quantities of biotite in a granodiorite might decrease the K/Rb ratio so drastically that it acquires a more differentiated character than a truely more differentiated leucocratic granite. In general, the Shait tonalites possess the highest K/Rb ratios (1015-346). The Hadidat tonalite has a lower ratio of 289 and the pink granite of Hammash has a still lower value of 278. These values lie within or above the limits of the main trend of Shaw (op. cit.). The decrease in the aforementioned K/Rb ratios is normal since the later intrusions are expectedly more differentiate than the earlier ones.

The foliated granite and Hemeish granite (marginal part) have the K/Rb ratios of 377 and 199 respectively. The relatively high ratio of the foliated granite contradicts with the more differentiated character of this mass as deduced from the distribution of Sr and Ba. This might be due, at least in part to the low biotite content. The very low K/Rb ratio and the high Li and Y content of the marginal part of the Hemeish granite ask for further study to elucidate if there is any relation between these outstanding geochemical features and the pegmatite mass occurring in the center of the mapped part of this pluton.

<u>Tin, Zirconium, Yttrium and Ytterbium</u>

The Shait tonalites (except No. 3) and the Hadidat tonalite possess very low Sn content. The Sn content increases al-

Structural analysis of the present area (El-Gaby <u>et al.</u>, 1976) suggests that the foliated granite belongs to the synorogenic plutonites and was intruded shortly after the gneissose tonalites. It is believed that the foliated granite can be correlated with the fine to medium-grained two mica granites accompanying or intruded shortly after the porphyritic synorogenic granite varieties, e.g. Um Takha white granite(El-Gaby and Ahmed, 1976) and the Newer Granite (Gindy, 1954).

The fine-grained marginal part of the Hemeish granite poses with its outstanding petrographical and petrochemical properties many problems. It cannot be correlated with certainity to any of the granite varieties known to the authors to occur in Egypt. It does not belong to the postorogenic alkaline granite series (El-Gaby and Ahmed, <u>op.cit.</u>) as the acid differentiates are more or less peralkaline granites containing reibeckite or aegirine. Also , it is not an 'apogranite ' (Sabet and Tsogoev, 1973) due to the absence of any alibitization or any pronounced secondary replacement features.It remains then to correlate the marginal part with the Upper Cretaceous magmatic activity: Wadi Natash Volcanics and associated ring structures (El-Ramly <u>et al.</u>, 1971) and the Cretaceous granites (El-Shazly <u>et al.</u>, 1973). If this assumption proves in the future to be valid, then it must be supposed that the local brecciation and cataclasis observed in the marginal part are due to rejuvenation of the old faults.Rejuvenation is highly probable due to the presence of Cretaceous trachtytes along the N-S fault crossing Gabal Sufra and along the major NW-SE fault traversing the northeastern corner of the map area.

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REFERENCES

Akaad, M.K., El-Gaby, S. & Habib, M.S. (1973): The Barud gneisses and the origin of the grey granite. Bull.Fac. Sci., Assiut Univ., 55-69.

Akaad, M.K. & El-Ramly, M.F. (1963): The cataclastic-mylonitic gneisses north of Gabal El Maiyit and the origin of the granite of Shaitian type. Geol. Surv. Cairo, paper No. 26.

Akaad, M.K. & Moustafa, G.A. (1963): The Shait granite:a cataclastic-mylonitic gneiss. Geol. Surv. Cairo, paper No. 19.

El-Gaby, S.(1975): Petrochemistry and geochemistry of some granites from Egypt. N. Jb. Miner. Abh.,124,147-189 .

El-Gaby, S. & Ahmed, A.A. (1976): The intrusive rocks at Wadi Feiran district, Southwestern Sinai, Egypt.In press.

El-Gaby, S., Sabet, A.H. & El-Aref, M. (1976): Geology of the basement rocks at Wadi Shait, Eastern Desert,Egypt. In press.

El-Ramly, M.F. & Akaad, M.K. (1960): The basement complex in the Central Eastern Desert of Egypt between latitudes 24° 30' and 25° 40'. Geol. Surv. Cairo, paper No. 8.

El-Ramly, M.F., Budanov, V.I. & Hussein, Abdel Aziz (1971) : The alkaline rocks of Southeastern Egypt.Geol.Survey Cairo, paper No. 53.

El-Shazly, E.M. (1964): On the classification of the Precambrian and other rocks of magmatic affiliation in Egypt. Intern. Geol. Congr., India, Section 10, 88-101.

El-Shazly, E.M., El-Sokkary, A.A. & Khalil, S.O. (1971): Petrography and geochemistry of some granite pebbles from metamorphosed conglomerates, Qift-Quseir Area, Eastern Desert. U.A.R. J.Geol., 15, 57-64.

El-Shazly, E.M., Hashad, A.H., Sayyah, T.A. & Bassyuni, F. A. (1973): Geochronology of Abu Swayel Area, South Eastern Desert. Egypt J. Geol., 17, 1-18.

El-Sokkary, A.A., (1970): Geochemical studies of some granites in Egypt. U.A.R. Ph.D. Thesis, Fac. Sci., Alexandria Univ.

Gindy, A.R. (1954): The plutonic history of the Aswan area, Egypt. Geol. Mag., 91, 484-497.

James, R.S. & Hamilton, D.L. (1972°: Phase relations in the system Na Al Si_3 O_8 - K Al Si_3 O_8 - Ca $Al_2Si_2O_8$-SiO_2 at 1 kilobar water vapour pressure. Conter. Miner. Petrol. 21, 111-141.

Luth, W.C., Jahns, R.H. & Tuttle, O.F. (1964): The granite system at pressures of 4 to 10 kilobars. J. Geophs.Res. 69, 759-773.

Moustafa, G.A. & Akaad, M.K. (1962): Geology of Hammash Sufra district. Geol. Surv. Cairo, paper No. 12.

Niggli, P. (1954): Rocks and mineral deposits. (English translation), Freeman & Co., San Fran.

Nockolds, S.R. (1954): Average chemical composition of some igneous rocks. Geol. Soc. Am. Bull., 65, 1007-1032.

Nockolds, R.S. & Allen, R. (1953): The geochemistry of some igneous rock series. Geochim. Cosmochim Acta, 4, 105 - 142.

Sabet, A.H. and Tsogoev, V. (1973): Problems of geological and economic evaluation of Tantalum deposits in apogranites during stages of prospection and exploration. Annals Geol. Surv. Egypt. 3, 87-107.

Saw, D.M. (1969): A review of K-Rb fractionation trends by covariance analysis. Geochim. Cosmochim. Acta, 32, 573-601.

Schurmann, H.M.E. (1953): The Precambrian of the Gulf of Suez area. Intern. Geol. Congr., Algeria. C.R. Sec. I, Fasc. 1.

Turekian, K.K. & Wedepohl, K.H. (1961): Distribution of the elements in some major units of the earth's crust. Geol. Soc. Am. Bull., 72, 175-192.

Tuttle, O.F. & Bowen, N.L. (1958): Origin of granite in the light of experimental studies in the system $NaAlSi_3O_8$ - $KAlSi_3O_8$ - SiO_2 - H_2O. Geol. Soc. Am. Mem., 74.

" دراسات جيولوجية وبتروكيميائية وجيو كيميائيه على الجرانيت
الشعيطى بوادى شعيط بالصحراء الشرقية بمصــــــــر "

سمير الجابى — مرتضى العارف

نتيجه لاعاده المسح الجيولوجى للجرانيت الشعيطى التيسوزى ، أمكن فصله الـــــى عدة متداخلات • كما أجرى تحليل كيميائى للعناصر الرئيسية ولعدد من العناصـر الضئيله لعينات تمثل مختلف المتداخلات الجرانيتية بالمنطقه •

وتدل المشاهدات الحقلية والتحاليل الكيميائية للصخور وتوزيع العناصر بها علـــى أن الجرانيت الشعيطى ذو التركيب التوناليتى ينتمى الى الممثلين الأوائل لمجموعه شبيهـــات الجرانيت المتداخلة أبان الحركة البانية للجبال — أى أنه يتبع مجموعة الجرانيت الرمادى •

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جامعة اسيوط

المجلد ٦ العدد ٢

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